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March 28, 2003
L-03-056

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: Beaver Valley Power Station, Unit No. 1 and No. 2
BV-1 Docket No. 50-334, License No. DPR-66
BV-2 Docket No. 50-412, License No. NPF-73
Proposed Alternative Repair Methods for Reactor Vessel Head Penetrations (Relief Request No. BV3-RV-04)

This letter is requesting expedited approval of an alternative reactor vessel head penetration repair method (embedded flaw repair).

During the ongoing Beaver Valley Power Station (BVPS) Unit 1 refueling outage, FirstEnergy Nuclear Operating Company (FENOC) is conducting inspections of the reactor vessel head penetrations (VHP) in accordance with NRC Order EA-03-009 dated February 11, 2003. Indications of flaws have been found on the outside diameter (OD) of four Control Rod Drive Mechanism (CRDM) VHPs below the J-groove attachment welds on the underside of the reactor vessel head.

The four CRDM VHPs with flaw indications were manufactured from common material subjected to the same heat treatment (Heat: M3935). Flaws were found in VHP tube material made in this heat at the Oconee and Arkansas Nuclear One power stations. No other BVPS Unit 1 VHP tubes were manufactured of material from this heat.

Pursuant to 10 CFR 50.55(a)(3)(i), FENOC is submitting Relief Request BV3-RV-04 to the requirements of Section XI of the ASME Code requesting authorization to use the embedded flaw repair technique. This technique would be used as an alternative to the requirements in the ASME Code, Section XI, that preclude welding over or embedding an existing flaw.

This relief request proposed alternative would allow use of an embedded flaw repair technique to repair flaws on the inside diameter (ID) and the the outside diameter (OD) of the VHPs as well as repair flaws on the J-groove attachment welds on VHPs. The proposed alternative method of embedded flaw repair has been shown to provide an acceptable level of quality and safety.

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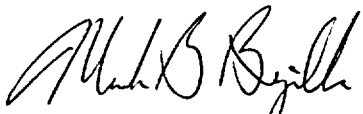
BVPS has recently identified the need to perform repairs using the embedded flaw repair technique during the current 1R15 refueling outage which began on March 8, 2003. Therefore, expedited approval of this Code alternative is requested.

No new commitments are contained in this submittal. If there are any questions regarding this matter, please contact Mr. Larry R. Freeland, Manager, Regulatory Affairs/Performance Improvement at 724-682-5284.

Sincerely,



Mark B. Bezilla

Enclosure

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. D. M. Kern, NRC Sr. Resident Inspector
Mr. H. J. Miller, NRC Region I Administrator

ENCLOSURE

Proposed Alternative Repair Method for Reactor Vessel Head Penetrations

Relief Request No. BV3-RV-04

Relief Request No. BV3-RV-04

Code Class: 1

Code References: 1989 Edition, No Addenda of The American Society of Mechanical Engineers (ASME) Code, Section III, NB-4450, Section XI, IWA- 4120, IWA-4310.

Examination Category: B-E

Item Numbers: B4.12, B4.11

System/Component: Control rod drive mechanisms (CRDM) nozzles (65 penetrations)
Reactor head vent nozzle (1 penetration)

Inspection Intervals: Third 10-Year ISI Interval (BV1)
Second 10-Year ISI Interval (BV2)

Code Requirement:

BVPS Units 1 and 2 are in the third and second ten-year inservice inspection intervals, respectively, using the 1989 Edition, No Addenda of ASME Code, Section XI.

ASME Section XI, IWA- 4120, "Rules and Requirements," states in part:

> (a) "Repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later Editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used...."

ASME Section XI, IWA-4310, Defect Removal Procedure, states in part:

> "Defects shall be removed or reduced in size in accordance with this Article...."

ASME Code, Section XI, sub-sections IWA- 4120 and IWA-4310, do not allow welding over or embedding an existing flaw.

Proposed Alternative:

As an alternative to the rules contained in the 1989 ASME Code, Section XI, sub-sections IWA-4120 and IWA-4310, which do not allow welding over or embedding an existing flaw, it is requested that the NRC approve the use of the proposed alternative method described below, which was presented to the NRC by Westinghouse Electric Company, LLC. on December 13, 2001, for repair of flaws on the inside diameter (ID) and outside diameter (OD) of VHPs and on the VHP J-groove attachment welds.

Any flaws requiring repair that are identified on reactor VHPs and on the J-groove attachment welds will be embedded with a weld overlay which will prevent further growth of the defects by isolating the flaws from the reactor coolant which might cause the flaws to propagate by primary water stress corrosion cracking (PWSCC).

For an inside diameter (ID) repair, an unacceptable axial flaw will be first excavated (or partially excavated) to a depth no greater than 0.125 inches. The excavation will be performed using an electric discharge machining process to minimize penetration tube distortion. After the excavation is complete, either an ultrasonic test (UT) or eddy current test (ECT) will be performed to ensure the entire flaw length is captured. Then an Alloy 52 weldment will be applied to fill the excavation. Finally, the finished weld will be examined by dye penetrant test (PT), UT or ECT to ensure acceptability. If an unacceptable ID circumferential flaw is detected, the flaw will either be repaired in accordance with existing code requirements, or will be partially excavated to reduce the flaw to an acceptable size, examined by UT or ECT, overlaid with Alloy 52, and examined by PT, UT or ECT as described above.

The outside diameter (OD) and J-groove weld repairs will be addressed as follows:

1. An unacceptable axial or circumferential flaw in a tube below a J-groove attachment weld will be sealed off with Alloy 52 weldment. Excavation or partial excavation of such flaws will not be required, since clearance is not a concern on the outside of a tube.

2. Unacceptable radial flaws on the J-groove attachment weld will be sealed off with a 360 degree overlay of Alloy 52 covering the entire weld. No excavation will be required.

3. Unacceptable axial tube flaws extending into the J-groove attachment weld will be sealed with Alloy 52 as in Item 1 above. In addition, the entire J-groove attachment weld will be overlaid with Alloy 52 to embed the axial crack in the seal weld on the VHP penetration.

4. For all of the above flaw configurations, the finished weld will be examined by PT, UT or ECT to ensure acceptability.

5. The embedded flaw repair weld will be three layers thick for applications to the J-groove attachment welds, and at least two layers thick for application to base metal locations.

6. For embedded flaw repairs involving flaws in the J-groove weld, an ultrasonic examination of the OD of the penetration immediately above the weld will be performed in the next scheduled NDE inspection to verify that no OD-connected circumferential flaws exist.

No attempt will be made to embed an outside diameter circumferential flaw above the J-groove weld. Whenever an embedded flaw repair is planned for a circumferential flaw or a J-groove weld repair, the NRC will be notified.

Basis for Alternative Requirements:

BVPS will be performing inspections of the vessel head penetrations (VHP) in accordance with the BVPS in response to the NRC Order dated February 11, 2003. In the event that any of these inspections indicate flaws in these penetrations, it will be necessary to repair such flaws. Pursuant to 10 CFR 50.55a(a)(3)(i), the alternative is proposed on the basis that it will provide an acceptable level of quality and safety.

The embedded flaw repair technique is considered a permanent repair for the following reasons:

1. As long as a Primary Water Stress Corrosion Cracking (PWSCC) flaw remains isolated from the primary water (PW) environment, it cannot propagate. Since Alloy 52 weldment is considered highly resistant to PWSCC, a new PWSCC flaw cannot initiate and grow through the Alloy 52 overlay to reconnect the PW environment with the embedded flaw. Structural integrity of the affected VHP J-groove attachment weld will be maintained by the remaining unflawed portion of the weld.

2. The residual stresses produced by the embedded flaw technique have been measured and found to be relatively low. This was documented in the attachment to a letter from E. E. Fitzpatrick, Indiana Michigan Power Company (I&M), to the Nuclear Regulatory Commission, "Reactor-Vessel Head Penetration Alternate Repair Techniques" (letter AEP:NRC:1218A, dated March 12, 1996). The low residual stresses indicate that no new flaws will initiate and grow in the area adjacent to the repair weld.

3. There are no other known mechanisms for significant flaw propagation in this region since cyclic fatigue loading is negligible.

In addition, the implementation of a more traditional repair would be a hardship, for the following reasons:

1. The dose estimate to perform an ASME Code-required repair is expected to be significantly higher than the dose estimate for the embedded flaw repair. Based on current industry experience, we estimate that the dose to perform an ASME Code-required repair may exceed 20 man-rem, while the man-rem estimate for the embedded flaw repair is approximately an order of magnitude lower.

2. Implementation of a traditional repair can be time consuming, and also involves increased risk, as the amount of structural deformation increases as the amount of deposited weld metal increases.

Conclusion:

10 CFR 50.55a(a)(3) states:

"Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:

(i) The proposed alternatives would provide an acceptable level of quality and safety, or

(ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."

BVPS considers the embedded flaw repair technique to be an alternative to Code requirements that provides an acceptable level of quality and safety, as required by 10 CFR 50.55a(a)(3)(i).

Precedent:

NRC has approved a similar alternative for North Anna Power Station Unit 2 on January 23, 2003. Additionally, the NRC previously approved a similar alternative for Cook Nuclear Plant, Units 1 and 2 on April 9, 1996. Although the alternative was applied to the VHP tube base metal rather than VHP welds, both alternatives use an embedded flaw repair technique.